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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/607,606	06/27/2003	Ramesh Gopalan	LAM2P419	7609

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EXAMINER	
CHEN, ERIC BRICE	
ART UNIT	**PAPER NUMBER**
1765	

DATE MAILED: 04/19/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/607,606	GOPALAN ET AL.	
	Examiner	Art Unit	
	Eric B. Chen	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 6/27/03.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) 17-20 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-16 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) 1-20 are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claim 1-16, drawn to a method, classified in class 438, subclass 691.

II. Claims 17-20, drawn to a system, classified in class 451, subclass 254.

2. The inventions are distinct, each from the other because of the following reasons: Inventions I and II are related as a method and system for its practice. The inventions are distinct if it can be shown that either: (1) the method as claimed can be practiced by another materially different system or by hand, or (2) the system as claimed can be used to practice another and materially different process. (MPEP § 806.05(e)). In this case, the system can be used for the controlled polishing or abrasion of any disc-shaped object. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

3. During a telephone conversation with Michael L. Gencarella on April 1, 2005, a provisional election was made without traverse to prosecute Invention I, claims 1-16. Affirmation of this election must be made by applicant in replying to this Office action. Claims 17-20 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

4. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one

or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Priority

5. Applicant is advised of possible benefits under 35 U.S.C. 119(a)-(d), wherein an application for patent filed in the United States may be entitled to the benefit of the filing date of a prior application filed in a foreign country.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 1-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Redeker et al. (U.S. Patent No. 6,602,724) in view of Sun et al. (U.S. Patent No. 6,010,538).

9. As to claim 1, Redeker discloses a method for planarizing a semiconductor substrate, comprising: tracking a signal corresponding to a thickness (Figure 11; column 9, lines 6-22) of conductive film (16) disposed on the substrate (10) (column 7, lines 31-34; Figure 7B); and identifying onset of planarization based upon a change in signal (column 9, lines 12-17).

10. Redeker does not expressly disclose calculating a second derivative from data representing the tracked signal; and identifying onset of planarization based upon a change in the second derivative. Sun discloses a method for planarizing a semiconductor substrate, comprising: tracking a signal corresponding to a thickness (column 9, lines 7-11; lines 43-52) of a conductive film (54) (column 7, lines 46-48) disposed on the semiconductor substrate (53) (Figure 6B); and calculating a second derivative from data representing the tracked signal (column 9, lines 36-39; Figures 8B-8D). Moreover, Sun teaches the general concept of calculating first and second derivatives of a tracked signal in order to more accurately discern slight variations in slope of the signal (column 9, lines 27-43). From Figure 11 of Redeker, a shift in slope from section (252) of the signal trace (indicating a rough surface) to section (254) is readily identifiable (column 9, lines 12-17). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include the steps of: calculating a second derivative from data representing the tracked signal; and

identifying onset of planarization based upon a change in the second derivative. One who is skilled in the art would be motivated to apply a technique in order to more accurately discern subtle shifts in the slope of a tracked signal.

11. As to claim 2, Sun discloses that detecting the signal from a probe that provides a linear response to a remaining amount of the conductive film (column 9, lines 27-43).

12. As to claim 3, Redeker discloses that the conductive film is copper (column 10, lines 33-34). Although the tracked signal is generated by an optical monitoring system (140) (column 8, lines 57-65), Redeker discloses that the CMP process is simultaneously monitored by an eddy current sensor (column 2, lines 55-63). Furthermore, the eddy current sensor (40) (column 6, lines 56-67) is capable of generating signals which can be correlated to the thickness of a metal film being polished (column 8, lines 6-10). The tracked signal in Figure 10 of Redeker also exhibits subtle shifts in slope. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use an eddy current sensor as a probe. One who is skilled in the art would be motivated to use a successfully implemented technique for the real time monitoring of metal thickness during a CMP process.

13. As to claim 4, Sun discloses that the method operation of calculating a second derivative from data representing the tracked signal includes, determining a second rate of change of a first rate of change, the first rate of change representing a slope associated with the tracked signal (column 9, lines 27-39).

14. As to claim 5, Redeker discloses that the method operation of identifying onset of planarization based upon a change in the second derivative includes, establishing a threshold signal level (shift in slope from (252) to (254) in Figure 11; column 9, lines 12-17). However, Redeker does not expressly disclose that once the threshold signal level is realized, the method includes, identifying a decrease of a value of the second derivative. Sun teaches the general concept of calculating first and second derivatives of a tracked signal in order to more accurately discern slight variations in slope of the signal (column 9, lines 27-43). Therefore, it would have been obvious to one of ordinary skill in the art to include the step of: identifying a decrease of a value of the second derivative once the threshold signal level is realized. One who is skilled in the art would be motivated to apply a technique in order to more accurately discern subtle shifts in the slope of a tracked signal.

15. As to claim 6, Redeker does not expressly disclose that the method operation of identifying a decrease of a value of the second derivative includes, establishing a drop level for the value of the second derivative; and monitoring the value of the second derivative; and once the value of the second derivative crosses the drop level, the method includes, adjusting planarization parameters associated with the planarization operation. However, Redeker discloses the general concept of adjusting planarization parameters associated with the planarization operation based on local minima or maxima, or changes in slope of the tracked signal (column 9, lines 55-65). Sun teaches the general concept of calculating first and second derivatives of a tracked signal in order to more accurately discern slight variations in slope of the signal (column 9, lines

27-43). From Figure 11 of Redeker, a shift in slope from section (252) of the signal trace (indicating a rough surface) to section (254) is readily identifiable (column 9, lines 12-17). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include the steps of: establishing a drop level for the value of the second derivative; and monitoring the value of the second derivative; and once the value of the second derivative crosses the drop level, the method includes, adjusting planarization parameters associated with the planarization operation. One who is skilled in the art would be motivated to apply a technique in order to more accurately discern subtle shifts in the slope of a tracked signal.

16. As to claim 7, Redeker discloses initiating a chemical mechanical planarization (CMP) operation under a first set of planarization parameters; and adjusting the CMP operation with a second set of planarization parameters after the onset of planarization (column 3, lines 24-39; column 9, lines 55-65).

17. As to claim 8, Redeker discloses that the method operation of adjusting the CMP operation with a second set of planarization parameters after the onset of planarization includes, decreasing both a down force applied to the semiconductor substrate and belt speed (column 10, lines 11-17; column 9, lines 55-65).

18. As to claim 9, Redeker discloses that the first set of planarization parameters include a first slurry composition and the second set of planarization parameters includes a second slurry, the second slurry being less abrasive than the first slurry (column 3, lines 5-10; column 10, lines 60-67; column 11, lines 64-67).

19. As to claim 10, Redeker discloses a method for determining when a substantially flat surface of a metal film has been achieved during a chemical mechanical planarization (CMP) operation, comprising: monitoring a signal corresponding to an amount of metal within a detection region (Figure 11; column 9, lines 6-22); establishing a threshold decrease associated with the rate of change (shift in slope from (252) to (254) in Figure 11; column 9, lines 12-17); and triggering a transition point when the rate of change crosses the threshold decrease associated with the rate of change (column 9, lines 55-65).

20. Redeker does not expressly disclose determining a rate of change over time of a removal rate. Sun discloses a method for planarizing a semiconductor substrate, comprising: tracking a signal corresponding to a thickness (column 9, lines 7-11; lines 43-52) of a conductive film (54) (column 7, lines 46-48) disposed on the semiconductor substrate (53) (Figure 6B). Moreover, Sun teaches the general concept of calculating first and second derivatives of a tracked signal in order to more accurately discern slight variations in slope of the signal (column 9, lines 27-43). From Figure 11 of Redeker, a shift in slope from section (252) of the signal trace (indicating a rough surface) to section (254) is readily identifiable (column 9, lines 12-17). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include the step of: determining a rate of change over time of a removal rate. One who is skilled in the art would be motivated to apply a technique in order to more accurately discern subtle shifts in the slope of a tracked signal.

21. As to claim 11, Sun discloses that detecting the signal responds linearly to a change of an amount of metal within the detection region (column 9, lines 27-43).

22. As to claim 12, Redeker does not expressly disclose that the method operation of determining a rate of change over time of a removal rate includes, converting the signal to a second derivative value of the signal; and tracking the second derivative value of the signal over time. Sun teaches the general concept of calculating first and second derivatives of a tracked signal in order to more accurately discern slight variations in slope of the signal (column 9, lines 27-43). From Figure 11 of Redeker, a shift in slope from section (252) of the signal trace (indicating a rough surface) to section (254) is readily identifiable (column 9, lines 12-17). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include the steps of: converting the signal to a second derivative value of the signal; and tracking the second derivative value of the signal over time. One who is skilled in the art would be motivated to apply a technique in order to more accurately discern subtle shifts in the slope of a tracked signal.

23. As to claim 13, Redeker discloses that in response to the method operation of triggering a transition point when the rate of change crosses the threshold decrease in the rate of change the method includes, adjusting processing parameters associated with the CMP operation (column 9, lines 55-65).

24. As to claim 14, Redeker discloses that the processing parameters include one of a belt speed and a down force pressure applied to a substrate being processed (column 10, lines 11-17; column 9, lines 55-65).

25. As to claim 15, Redeker discloses that in response to the method operation of triggering a transition point when the rate of change crosses the threshold decrease in the rate of change the method includes, stopping the CMP operation; and changing a current polishing pad to a softer polishing pad (column 3, lines 5-10; column 10, lines 60-67).

26. As to claim 16, Redeker discloses replacing a current slurry with a less abrasive slurry (column 3, lines 5-10; column 10, lines 60-67; column 11, lines 64-67).

Conclusion

27. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Litvak (U.S. Patent No. 5,499,733) discloses a polishing method in which endpoint is detected by monitoring the intensity of a radiation beam.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B. Chen whose telephone number is (571) 272-2947. The examiner can normally be reached on Monday through Friday, 8AM to 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

EBC EBC
April 7, 2005

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER